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(54) SEALANT, METHOD OF SEALING FOR SEMICONDUCTOR DEVICE OR THE LIKE, METHOD OF PRODUCTION FOR SEMICONDUCTOR DEVICE, AND SEMICONDUCTOR DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a sealant having high practicality with low viscosity, rapid curing at low temperature, and to provide a method of sealing for electronic parts, electric circuits, electric contacts or semiconductors, or a method of production for semiconductor device and to provide a semiconductor device comprising semiconductors sealed by the same.

SOLUTION: The sealant contains (A) an organic compound which has at least two carbon-carbon double bonds reactive with SiH groups in the molecule, (B) a compound having at least two SiH groups in the molecule, (C) a catalyst for hydrosilylation, and (D) a filler, as essential components.

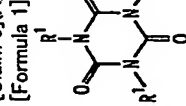
* NOTICES *

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CLAIMS

- [Claim (s)]
- [Claim 1](A) Encapsulant containing an organic compound which contains a carbon-carbon double bond which has a SiH group and reactivity in [at least two] one molecule, a compound which contains at least two SiH groups in one molecule (B), the (C) hydrosilylation catalyst, and the (D) filler as an essential ingredient.
- [Claim 2](A) The encapsulant according to claim 1 being that in which an ingredient contains 0.001 mol or more per g of (A) ingredient of carbon-carbon double bonds which have a SiH group and reactivity.
- [Claim 3](A) Claim 1, wherein ingredients are C, H, N, O, S, and a thing that consists only of halogen as a composing element, or encapsulant given in 2.
- [Claim 4](A) The encapsulant according to any one of claims 1 to 3 making that an ingredient contains 1-6 vinyl groups in one molecule of (b)s, that a (**) molecular weight is less than 900, and for viscosity in (**) 23 ** to be less than 1000 poise into an indispensable condition.
- [Claim 5](A) An ingredient is following general formula (I).



(I)

(the organic group of the monovalence of the carbon numbers 1-50 may be expressed, and each R¹ may differ or those of R¹ in a formula may be the same.) — the encapsulant according to any one of claims 1 to 4 being an organic compound expressed.

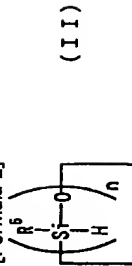
[Claim 6](B) Encapsulant given in any 1 paragraph of claims 1 thru/or 5, wherein molecular weights of an ingredient are 50-700.

[Claim 7]The encapsulant according to any one of claims 1 to 6 being a compound characterized by comprising the following which can obtain a chain and/or annular polyorganosiloxane (beta) by the ability to carry out a hydrosilylation reaction.

(B) An organic compound in which an ingredient contains a carbon-carbon double bond which has a SiH group and reactivity in [one or more] one molecule (alpha). They are at least two SiH groups in one molecule.

[Claim 8](beta) An ingredient is following general formula (II).

[Formula 2]



(I I)

(among a formula, R² expresses the organic group of the carbon numbers 1-6, and n expresses the number of 3-10.) — the encapsulant according to claim 7 being the annular polyorganosiloxane which is expressed, and which has at least three SiH groups in one molecule.

[Claim 9](D) The encapsulant according to any one of claims 1 to 8, wherein an ingredient is a silica system filler.

[Claim 10](D) The encapsulant according to any one of claims 1 to 9, wherein an ingredient is a filler with a mean particle diameter of 10 micrometers or less.

[Claim 11](D) The encapsulant according to any one of claims 1 to 10 in which an ingredient is characterized by content of a particle with a particle diameter of not less than 50 micrometers being 1 or less % of the weight of a filler.

[Claim 12](D) The encapsulant according to any one of claims 1 to 11 being a filler with a spherical ingredient

[Claim 13]The encapsulant according to any one of claims 1 to 12, wherein viscosity at 23 ** is 1000 or less Pa-s.

[Claim 14]The encapsulant according to any one of claims 1 to 13, wherein penetration time to the 50-micrometer crevice at 60 ** is 120 or less seconds/cm.

[Claim 15]The encapsulant according to any one of claims 1 to 14, wherein weight loss under hardening is 5 or less % of the weight

[Claim 16]The encapsulant according to any one of claims 1 to 15, wherein gel time at 120 ** of a hardened material is less than 120 seconds.

[Claim 17]The encapsulant according to any one of claims 1 to 16, wherein Tg of a hardened material is not less than 100 **.

[Claim 18]The encapsulant according to any one of claims 1 to 17 whose extraction ion content from a hardened material is less than 10 ppm.

[Claim 19]The encapsulant according to any one of claims 1 to 18 used in order to close a semiconductor.

[Claim 20]Under-filling which consists of the encapsulant according to claim 19.

[Claim 21]Electronic parts closing electronic parts, an electric circuit, or electric contact with encapsulant of a statement in any 1 paragraph of claims 1 thru/or 18, an electric circuit, a sealing method of electric contact

[Claim 22]A sealing method of a semiconductor closing a semiconductor by encapsulant according to claim 19 or the under-filling according to claim 20.

[Claim 23]A manufacturing method of a semiconductor device closing a semiconductor by encapsulant according to claim 19 or the under-filling according to claim 20.

[Claim 24]A semiconductor device with which encapsulant according to claim 19 or the under-filling according to claim 20 comes to close a semiconductor.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The encapsulant whose practicality this invention relates to encapsulant, are hypoviscosity and low-temperature fast curability in more detail, and is high, it is related with the sealing method of the electronic parts which close electronic parts, an electric circuit, electric contact, or a semiconductor by it, an electric circuit, or a semiconductor or the manufacturing method of a semiconductor device, and the semiconductor device with which it comes to close a semiconductor.

[0002]

[Description of the Prior Art] As encapsulant, especially encapsulant for semiconductors, the epoxy resin composition which used the polyfunctional epoxy compound, the phenol novolac system hardening agent, and the inorganic filler as the main ingredients is used widely. With the miniaturization demand of a semiconductor package, etc. in recent years TAB closure, Liquefied encapsulants including the under-filling closure for flip chip bonding, etc. are used, and the epoxy resin composition which mainly used the epoxy compound, the acid anhydride system hardening agent, and the inorganic filler as the main ingredients is widely used for these liquefied encapsulants. The fundamental characteristic required of such encapsulants is heat resistance, an adhesive property, etc. which do not make parts produce fault also by heat histories, such as a solder reflow.

[0003] Generally, hardening takes an elevated temperature and a long time to an epoxy resin composition, manufacture of a semiconductor package etc. is difficult for it, and although a manufacturing cycle may become long, in order to manufacture easily, to make a cycle quick and to reduce a manufacturing cost, low-temperature fast curability is demanded. In liquefied encapsulant, the high-speed perviousness to the slit by the further fluid improvement by enlargement of a semiconductor and densification, etc. is called for.

[0004] In order to improve low-temperature fast curability and high-speed perviousness which were described above, various improvement is proposed in the epoxy resin (JP 5-222270.A, JP 6-5743.A, JP 6-206982.A, JP 7-165876.A, JP 9-31161.A, JP 9-246435.A, JP 10-101906.A, JP 11-21421.A, JP 11-92549.A, JP 11-140069.A, JP 11-255864.A, JP 11-256012.A, JP 11-269250.A, JP 2000-3982.A, JP 2000-7891.A, JP 2000-53844.A, JP 2000-63630.A).

[0005] On the other hand, the hardenability constituent in which hardening generally used the quick hydrosilylation reaction for the hardening reaction is also proposed (JP 50-100.A, JP 9-291214.A, JP 1-126336.A, JP 5-295270.A).

[0006]

[Problem(s) to be Solved by the Invention] Therefore, the encapsulant whose practicality the purposes of this invention are hypoviscosity and low-temperature fast curability, and is high, it is providing the sealing method of the electronic parts which close electronic parts, an electric circuit, electric contact, or a semiconductor by it, an electric circuit, or a semiconductor or the manufacturing method of a semiconductor device, and the semiconductor device with which it comes to close a semiconductor.

[0007]

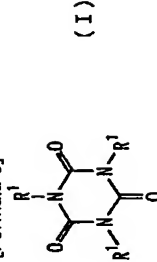
[Means for Solving the Problem] An organic compound in which this invention persons contain wholeheartedly a carbon-carbon double bond which has the (A) SiH group and reactivity in [at least two] one molecule as a result of research in order to solve this technical problem, (B) By considering it as

encapsulant containing a compound which contains at least two SiH groups in one molecule, the (C) hydrosilylation catalyst, and (D) silica system bulking agent as an essential ingredient, it found out that an aforementioned problem was solvable and resulted in this invention.

[0008] Namely, an organic compound in which this invention contains a carbon-carbon double bond which has the (A) SiH group and reactivity in [at least two] one molecule, (B) A compound, the (C) hydrosilylation catalyst which contain at least two SiH groups in one molecule, (D) It is the encapsulant (claim 1) containing a filler as an essential ingredient, (A). It is characterized by being that in which an ingredient contains 0.001 mol or more per g of (A) ingredient of carbon-carbon double bonds which have a SiH group and reactivity. Are the encapsulant (claim 2) according to claim 1, and the (A) ingredient as a composing element C, It is claim 1 being H, N, O, S, and a thing that consists only of halogen, or encapsulant (claim 3) given in 2, and the (A) ingredient contains 1-6 vinyl groups in one molecule of (b)s, (***) that a molecular weight is less than 900 and (***) — it is the encapsulant (claim 4) according to any one of claims 1 to 3 making for viscosity at 23 ° to be less than 1000 poise into an indispensable condition — the (A) ingredient — following general formula (I)

[0009]

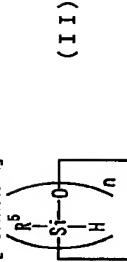
[Formula 3]



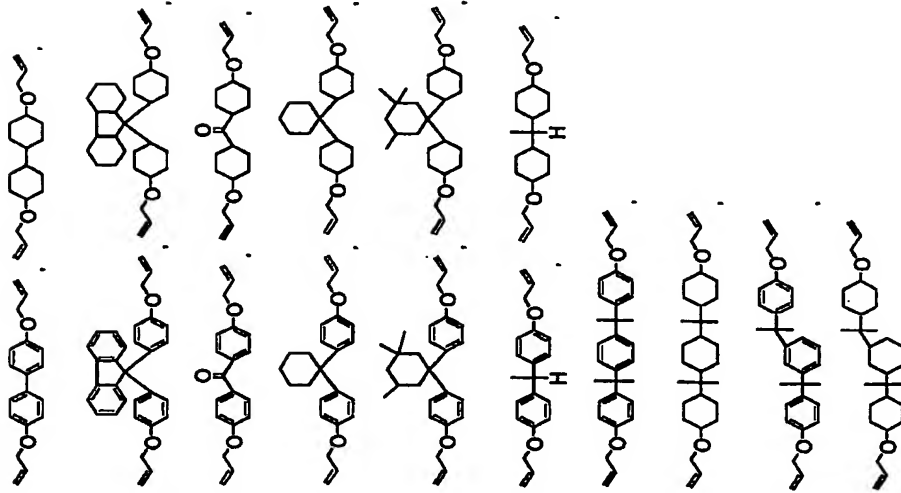
(the organic group of the monovalence of the carbon numbers 1-50 may be expressed, and each R¹ may differ or that of R¹ in a formula may be the same.) — it being the encapsulant (claim 5) according to any one of claims 1 to 3 by which it is characterized, and that it is an organic compound expressed, (B) It is an encapsulant (claim 6) given in any 1 paragraph of claims 1 thru/or 5, wherein the molecular weights of an ingredient are 50-700, (B) The organic compound (alpha) in which an ingredient contains the carbon-carbon double bond which has a SiH group and reactivity in [one or more] one molecule, The chain and/or annular polyorganosiloxane (beta) which has at least two SiH groups in one molecule, It is the encapsulant (claim 7) according to any one of claims 1 to 6 being a compound which can be obtained by the ability to carry out a hydrosilylation reaction, and an ingredient (beta) is following general formula (II).

[0010]

[Formula 4]



(R² expresses the organic group of the carbon numbers 1-6 among a formula, and n expresses the number of 3-10.) — it is expressed, It is the encapsulant (claim 8) according to claim 7 being the annular polyorganosiloxane which has at least three SiH groups in one molecule, (D) It is the encapsulant (claim 9) according to any one of claims 1 to 8, wherein an ingredient is a silica system filler, (D) It is the encapsulant (claim 10) according to any one of claims 1 to 9, wherein an ingredient is a filler with a mean particle diameter of 10 micrometers or less, (D) An ingredient is the encapsulant (claim 11) according to any one of claims 1 to 10, wherein the content of a particle with a particle diameter of not less than 50 micrometers is 1 or less % of the weight of a filler, (D) It is the encapsulant (claim 12) according to any one of claims 1 to 11 being a filler with a spherical ingredient, It is the encapsulant (claim 13) according to any one of claims 1 to 12, wherein the viscosity at 23 ° is 1000 or less Pa-s, It is the encapsulant (claim 14) according to any one of claims 1 to 13, wherein the penetration time to the 50-micrometer crevice at 60 ° is 120 or less seconds/cm, It is the encapsulant (claim 15) according to any one of claims 1 to 14, wherein the weight loss under hardening is 5 or less % of the weight, It is the encapsulant (claim 16)



What transposed a part or all of the glycidyl group of the conventionally publicly known epoxy resin besides ** to the allyl group is mentioned.

[0031](A) The low molecular weight compound which is divided into a skeletal part and a carbon-carbon double bond as mentioned above, and is hard to express as an ingredient can also be used. As an example of these low molecular weight compounds, butadiene, isoprene, Aliphatic series chain polyene compound systems, such as octadiene and decadiene, a cyclopentadiene, Substitution aliphatic series cyclic olefin compound systems, such as aliphatic series cyclic polyene compound systems, such as cyclohexadiene, cyclo-octadiene, a dicyclopentadiene, tricyclo pentadiene, and norbornadiene, vinylcyclopentene, and a vinylcyclohexene, etc. are mentioned.

[0032](A) As an ingredient, heat resistance from a viewpoint that it may improve more. A thing containing 0.001 mol or more per g of (A) ingredient of carbon-carbon double bonds which have a SiH group and reactivity is preferred, what is contained 0.005 mol or more per g is more preferred, and what is contained 0.008 mol or more is still more preferred.

[0033](A) As for a SiH group of an ingredient, and the number of carbon-carbon double bonds which have reactivity, even if small [per molecule] on the average, it is preferred [with two pieces], although it is good to exceed 2 to improve dynamics intensity more, and it is more preferred that they are three or more pieces. (A) When a SiH group of an ingredient and the number of carbon-carbon double bonds which have reactivity are one or less per 1 intramolecular, even if it reacts to the (B) ingredient, it does not become the structure of cross linkage only by becoming graft structure.

[0034](A) It is preferred that reactivity contains one or more vinyl groups in one molecule from a viewpoint of being good, as an ingredient, and it is more preferred to contain two or more vinyl groups in one molecule. It is preferred to contain six or less vinyl groups in one molecule from a viewpoint that storage stability becomes good easily, and it is more preferred to contain four or less vinyl groups in one molecule. [0035](A) As an ingredient, from a viewpoint that dynamic heat resistance is high, and a viewpoint that there is little cobwebbing nature of raw material liquid, and a moldability and handling nature are good, less than 900 thing has a preferred molecular weight, less than 700 thing is more preferred, and less than 500 thing is still more preferred.

[0036](A) As an ingredient, in order to acquire uniform mixing with other ingredients, and good workability, as viscosity, a thing below 1000 poise is preferred in 23 **, a thing below 300 poise is more preferred, and a thing below 30 poise is still more preferred. Viscosity can be measured with E type viscosity meter.

[0037](A) What has few content of a compound which has a derivative of a phenolic hydroxyl group and/, or a phenolic hydroxyl group from a viewpoint of coloring, especially control of yellowing as an ingredient is preferred. What does not contain a compound which has a derivative of a phenolic hydroxyl group and/, or a phenolic hydroxyl group is preferred. With a phenolic hydroxyl group in this invention, the benzene ring, a naphthalene ring, A hydroxyl group coupled directly with an aromatic hydrocarbon core illustrated by anthracene ring etc. is shown. A derivative of a phenolic hydroxyl group shows a basis replaced in a hydrogen atom of an above-mentioned phenolic hydroxyl group by acyl groups, such as alkenyl groups, such as alkyl groups, such as a methyl group and an ethyl group, a vinyl group, and an allyl group, and an acetoxy group, etc.

[0038]While an optical property is good like a photoelastic coefficient with a low double refraction factor being low, weatherability from a viewpoint of being good. That whose component weight ratio in the (A) ingredient of an aromatic ring is 50 or less % of the weight is preferred, 40 or less % of the weight of a thing is more preferred, and 30 or less % of the weight of a thing is still more preferred. Most desirable one does not include aromatic hydrocarbon rings.

[0039]From a viewpoint that there is little coloring of a hardened material obtained, optical transparency is high, and lightfastness is high. As an ingredient, (A) A vinylcyclohexene, a dicyclopentadiene, Triallyl isocyanurate, diaryl ether of 2,2-bis(4-hydroxycyclohexyl)propane, 1,2,4-TORIBI nil cyclohexane is preferred and triallyl isocyanurate, diaryl ether of 2,2-bis(4-hydroxycyclohexyl)propane, and especially 1,2,4-TORIBI nil cyclohexane are preferred.

[0040](A) As an ingredient, it may have other reactant groups. As a reactant group in this case, an epoxy group, an amino group, a radical polymerization nature unsaturation group, a carboxyl group, an isocyanate group, hydroxyl, alkoxy silyl groups, etc. are mentioned. When it has these functional groups, intensity of a hardened material obtained by the adhesive property of a hardenability constituent obtained becoming high easily becomes high easily. From a point that an adhesive property can become higher, an epoxy group is preferred among these functional groups. In a point that the heat resistance of a hardened material obtained becomes high easily, it is preferred to average a reactant group and to have in [one or more] one molecule.

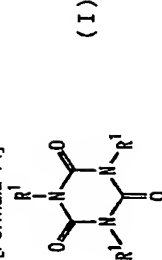
[0041](A) Independent, two or more sorts of things are mixed, and an ingredient can be used.

(General formula (I))

(A) Following general formula (I) from a viewpoint that heat resistance and transparency are high as an ingredient

[0042]

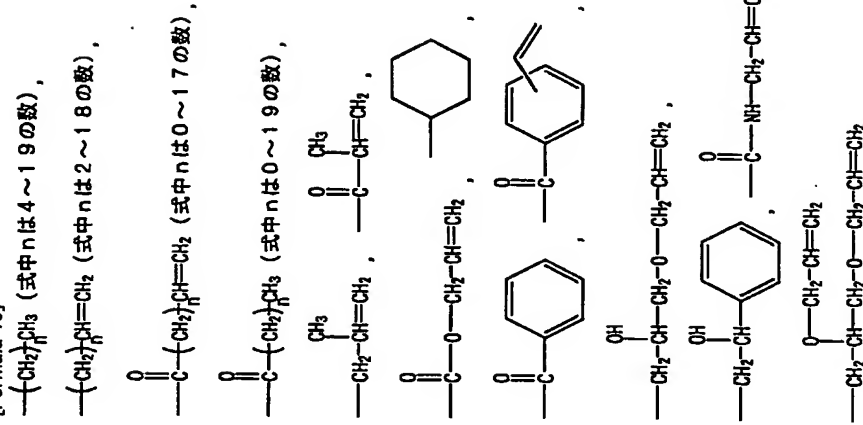
[Formula 14]



(the organic group of the monovalence of the carbon numbers 1-50 may be expressed, and each R¹ may differ or that of R¹ in a formula may be the same.) — the compound expressed is preferred.

[0043] From a viewpoint that the heat resistance of the hardened material obtained can become higher as R¹ of the above-mentioned general formula (I). It is preferred that it is an organic group of the monovalence of the carbon numbers 1~20, it is more preferred that it is an organic group of the monovalence of the carbon numbers 1~10, and it is still more preferred that it is an organic group of the monovalence of the carbon numbers 1~4. As an example of these desirable R¹, they are a methyl group, an ethyl group, a propyl group, a butyl group, a phenyl group, benzyl, a phenethyl group, a vinyl group, an allyl group, and a glycidyl group. [0044]

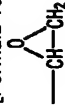
[Formula 15]



** is mentioned.

[0045] It is preferred that it is an organic group of the monovalence of the carbon numbers 1~50 in which at least one of three R¹ contains one or more epoxy groups from a viewpoint that an adhesive property with the various materials of the hardened material obtained can become good as R¹ of the above-mentioned general formula (I). [0046]

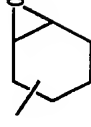
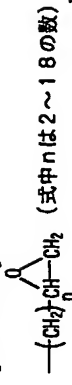
[Formula 16]



It is more preferred that it is an organic group of the monovalence of the carbon numbers 1~50 which comes out and contains one or more epoxy groups expressed. As an example of these desirable R¹, it is a

glycidyl group, [0047]

[Formula 17]



** is mentioned.

[0048] From a viewpoint that the chemical thermal stability of a hardened material obtained can become good as R¹ of the above-mentioned general formula (I). It is preferred that it is an organic group of monovalence of the carbon numbers 1~50 which contain two or less oxygen atoms, and contain only C, H, and O as a composing element, and it is more preferred that it is a hydrocarbon group of monovalence of the carbon numbers 1~50. As an example of these desirable R¹, they are a methyl group, an ethyl group, a propyl group, a butyl group, a phenyl group, benzyl, a phenethyl group, a vinyl group, an allyl group, and a glycidyl group. [0049]

---(CH₂)_nCH₃ (式中 n は 4 ~ 9 の数),

---(CH₂)_nCH=CH₂ (式中 n は 2 ~ 4 8 の数),

---C(---(CH₂)_nCH=CH₂) (式中 n は 0 ~ 4 7 の数),

---C(---(CH₂)_nCH₃) (式中 n は 0 ~ 4 9 の数),

---CH₂---CH=CH₂, ---C(---CH=CH₂),

---C(---O---CH₂---CH=CH₂), ---C(---O---CH₂---CH=CH₂),

---CH₂---CH(OH)---CH₂---O---CH₂---CH=CH₂, ---CH₂---CH(OH)---CH₂---O---C(---O---CH₂---CH=CH₂),

---O---CH₂---CH=CH₂, ---CH₂---CH(OH)---CH₂---O---CH₂---CH=CH₂

It is more preferred that it is an organic group of the monovalence of the carbon numbers 1~50 in which at least one of three R¹ contains one or more epoxy groups from a viewpoint that an adhesive property with the various materials of the hardened material obtained can become good as R¹ of the above-mentioned general formula (I). [0046]

[Formula 16]



It is more preferred that it is an organic group of the monovalence of the carbon numbers 1~50 which comes out and contains one or more epoxy groups expressed. As an example of these desirable R¹, it is a

glycidyl group, [0047]

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[0048] From a viewpoint that the chemical thermal stability of a hardened material obtained can become good as R¹ of the above-mentioned general formula (I). It is preferred that it is an organic group of monovalence of the carbon numbers 1~50 which contain two or less oxygen atoms, and contain only C, H, and O as a composing element, and it is more preferred that it is a hydrocarbon group of monovalence of the carbon numbers 1~50. As an example of these desirable R¹, they are a methyl group, an ethyl group, a propyl group, a butyl group, a phenyl group, benzyl, a phenethyl group, a vinyl group, an allyl group, and a glycidyl group. [0049]

---(CH₂)_nCH₃ (式中 n は 4 ~ 9 の数),

---(CH₂)_nCH=CH₂ (式中 n は 2 ~ 4 8 の数),

---C(---(CH₂)_nCH=CH₂) (式中 n は 0 ~ 4 7 の数),

---C(---(CH₂)_nCH₃) (式中 n は 0 ~ 4 9 の数),

---CH₂---CH=CH₂, ---C(---CH=CH₂),

---C(---O---CH₂---CH=CH₂), ---C(---O---CH₂---CH=CH₂),

---CH₂---CH(OH)---CH₂---O---CH₂---CH=CH₂, ---CH₂---CH(OH)---CH₂---O---C(---O---CH₂---CH=CH₂),

---O---CH₂---CH=CH₂, ---CH₂---CH(OH)---CH₂---O---CH₂---CH=CH₂

It is more preferred that it is an organic group of the monovalence of the carbon numbers 1~50 in which at least one of three R¹ contains one or more epoxy groups from a viewpoint that an adhesive property with the various materials of the hardened material obtained can become good as R¹ of the above-mentioned general formula (I). [0046]

[Formula 16]



It is more preferred that it is an organic group of the monovalence of the carbon numbers 1~50 which comes out and contains one or more epoxy groups expressed. As an example of these desirable R¹, it is a

glycidyl group, [0047]

[Formula 17]



** is mentioned.

[0050]As R¹ of the above-mentioned general formula (I), it is at least one of three R¹ from a viewpoint that reactivity becomes good. [0051]



It is preferred that it is an organic group of the monovalence of the carbon numbers 1-50 which come out and contain one or more bases expressed, and it is following general formula (III).

[0052]

[Formula 20]



(R³ in a formula expresses a hydrogen atom or a methyl group.) — it is more preferred that it is an organic group of the monovalence of the carbon numbers 1-50 containing one or more bases expressed — the inside of three R¹ — at least two — following general formula (V)

[0053]

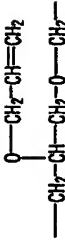
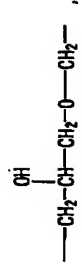
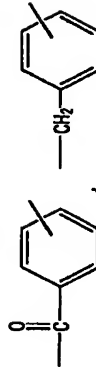
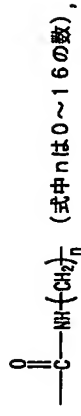
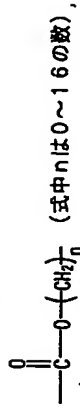
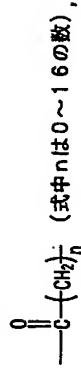
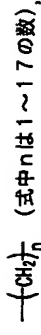
[Formula 21]



(R⁵ in a formula an organic group of bivalence of direct coupling or the carbon numbers 1-48) [express and] R⁶ expresses a hydrogen atom or a methyl group. It is still more preferred that it is an organic compound (two or more R⁵ and R⁶ may differ from each other, respectively, or may be the same.) expressed.

[0054]Although R⁵ of the above-mentioned general formula (V) is an organic group of bivalence of direct coupling or the carbon numbers 1-48, From a viewpoint that the heat resistance of a hardened material obtained can become higher. It is preferred that it is an organic group of bivalence of direct coupling or the carbon numbers 1-20, it is more preferred that it is an organic group of bivalence of direct coupling or the carbon numbers 1-10, and it is still more preferred that it is an organic group of bivalence of direct coupling or the carbon numbers 1-4. As the example of these desirable R⁵, [0055]

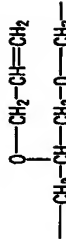
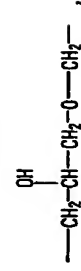
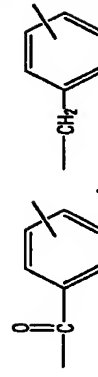
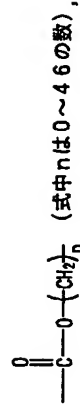
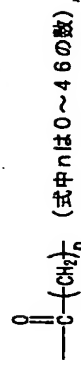
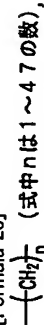
[Formula 22]



** is mentioned.

[0056]From a viewpoint that the chemical thermal stability of a hardened material obtained can become good as R⁵ of the above-mentioned general formula (V). It is preferred that it is an organic group of bivalence of the carbon numbers 1-48 which contain direct coupling or two oxygen atoms or less, and contain only C, H, and O as a composing element, and it is more preferred that it is a hydrocarbon group of bivalence of direct coupling or the carbon numbers 1-48. As the example of these desirable R⁵, [0057]

[Formula 23]



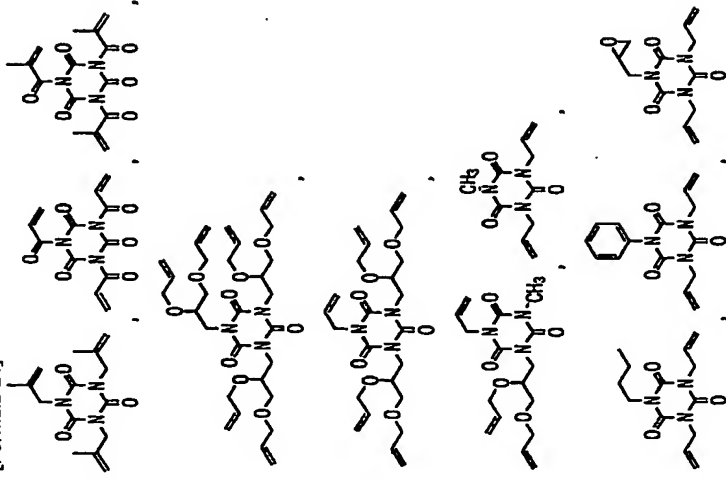
*****.

[0058]Although R⁶ of the above-mentioned general formula (V) is a hydrogen atom or a methyl group, from a viewpoint that reactivity is good, its hydrogen atom is preferred.

[0059]However, also in the desirable example of an organic compound expressed with the above general formula (I)s, it is required to contain the carbon-carbon double bond which has a SiH group and reactivity in [at least two] one molecule. It is more preferred that it is an organic compound which contains the carbon-carbon double bond which has a SiH group and reactivity from a viewpoint that heat resistance may be improved more in [three or more] one molecule.

[0060]As a desirable example of an organic compound expressed with the above general formula (I)s, it is triallyl isocyanurate, [0061]

[Formula 24]



** is mentioned.

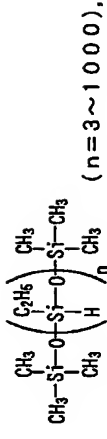
[0062]From the viewpoint of having the (B) ingredient and good compatibility, and a viewpoint of being hard to produce the problem of the outgas from encapsulant that the volatility of the (A) ingredient can become low. (A) A SiH group which was described above as an example of an ingredient, one or more sorts of compounds chosen from the organic compound which contains the carbon-carbon double bond which has reactivity in [at least two] one molecule, and a reactant with the chain and/or annular organopolysiloxane (beta) which have a SiH group are also preferred.

(beta) (ingredient)

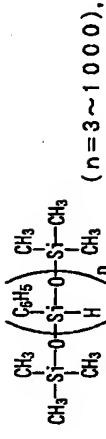
(beta) An ingredient is a chain and/or annular polyorganosiloxane which has a SiH group.

[0063]concrete — for example [0064]

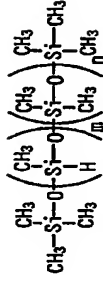
[Formula 25]



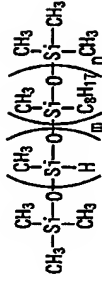
(n = 3 ~ 1000).



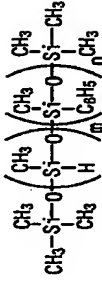
(n = 3 ~ 1000).



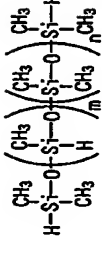
(m = 3 ~ 1000, n = 0 ~ 1000)



(m = 3 ~ 1000, n = 0 ~ 1000)



(m = 3 ~ 1000, n = 0 ~ 1000)



(m = 1 ~ 1000, n = 0 ~ 1000)

[0065]

[Formula 26]

and a maximum of a desirable addition receives 1 mol of SiH groups of an ingredient (beta) — 10^{-1} mol — it is 10^{-2} mol more preferably.

[0077] It is possible to use a co-catalyst together for the above-mentioned catalyst, and as an example the Lynn system compounds, such as triphenyl phosphine, Amine system compounds, such as sulfur—systems compounds, such as sulfur of acetylene alcohol system compounds, such as 1, such as dimethyl maleate, 2-diester system compound, and a 2-hydroxy-2-methyl-1-butene, and a simple substance, and triethylamine, etc. are mentioned. a minimum [as opposed to / although an addition in particular of a co-catalyst is not limited / 1 mol of hydrosilylation catalysts] of a desirable addition — 10^{-2} mol — it is 10^{-1} mol more preferably — a maximum of a desirable addition — 10^{-2} mol — it is 10 mol more preferably. [0078] Although various methods can be taken as the method of mixing of an organic compound which contains a carbon-carbon double bond which has a SiH group in a case of making it react, and reactivity in [at least two] one molecule, an ingredient (beta), and a catalyst, A method of mixing ***** (beta) for what mixed a catalyst to an organic compound which contains a carbon-carbon double bond which has a SiH group and reactivity in [at least two] one molecule is preferred. Control of a reaction is difficult in case of a method of mixing a catalyst into an organic compound which contains a carbon-carbon double bond which has a SiH group and reactivity in [at least two] one molecule, and a mixture of an ingredient (beta). (beta) Since it has moisture and reactivity which an ingredient is mixing under existence (beta) of a catalyst when taking a method of mixing an organic compound which contains a carbon-carbon double bond which has a SiH group and reactivity in what mixed a catalyst with an ingredient in [at least two] one molecule, it may deteriorate.

[0079] Although many things can be set up as reaction temperature, 30 °C of minimums of a desirable temperature requirement are 50 °C more preferably in this case, and 200 °C of maximums of a desirable temperature requirement are 150 °C more preferably. It is not practical if reaction time for making it fully react will become long if reaction temperature is low, and reaction temperature is high. Although a reaction may be performed at a fixed temperature, a multi stage story or per-continuum temperature may be changed if needed.

[0080] A pressure of reaction time and reaction time can also be set up variously if needed.

[0081] A solvent may be used in the case of a hydrosilylation reaction. A solvent which can be used is not what is limited especially unless a hydrosilylation reaction is checked, if it illustrates concretely, hydrocarbon system solvents, such as benzene, toluene, hexane, and heptane, Halogen system solvents, such as ketone solvent [such as ether system solvents, such as tetrahydrofuran 1, 4-dioxane, 1,3-dioxolane and diethylether, acetone, and methyl ethyl ketone], chloroform, methylene chloride, 1, and 2-dichloroethane, can be used conveniently. A solvent can also be used as two or more kinds of mixed solvents. As a solvent, toluene, a tetrahydrofuran, 1,3-dioxolane, and chloroform are preferred. The amount of solvents to be used can also be set up suitably.

[0082] In addition, various additive agents may be used for the purpose of controlling reactivity etc.

[0083] After making an organic compound and an ingredient (beta) which contain a carbon-carbon double bond which has a SiH group and reactivity in [at least two] one molecule react, An organic compound or/ and (beta) an ingredient which contain a carbon-carbon double bond which has a solvent or/, and an unreacted SiH group and reactivity in [at least two] one molecule are also removable. Since the (A) ingredient obtained does not have volatile matter content, it is hard to produce a problem of a void by volatilization of volatile matter content, and a crack by removing such volatile matter content in hardening with the (B) ingredient. As a method of removing, processing by activated carbon, aluminum silicate, silica gel, etc. besides for example, decompression devolatilization, etc. are mentioned. When carrying out decompression devolatilization, processing at low temperature is preferred. A maximum of a desirable temperature in this case is 100 °C, and is 60 °C more preferably. If it processes at an elevated temperature, it will be easy to be accompanied by deterioration of thickening etc.

[0084] As an example of the (A) ingredient which is an organic compound and a reactant of an ingredient (beta) which contain a carbon-carbon double bond which has above SiH groups and reactivity in [at least two] one molecule, A reactant of bisphenol A diaryl ether and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of a vinylcyclohexene and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of a reactant of divinylbenzene and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of a dicyclopentadiene and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of triallyl isocyanurate, a

reactant of 1,3,5,7-tetramethyl cyclotetrasiloxane and diaryl monoglycidyl isocyanurate, and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, etc. can be mentioned. A compound which has a SiH group which are ((B) ingredient), next the (B) ingredient is explained.

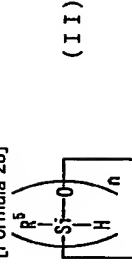
[0085] The (B) ingredient of this invention is a compound which contains at least two SiH groups in one molecule.

[0086] (B) It is a compound which there will be no restriction especially if it is a compound which contains at least two SiH groups in one molecule about an ingredient, for example, is indicated to international publication WO96/15194, and what has at least two SiH groups in one molecule can be used.

[0087] From a field of availability, it is following general formula (II) further among these from a viewpoint that a chain and/or annular organopolysiloxane which have at least two SiH groups are preferred in one molecule, and compatibility with the (A) ingredient is good for it.

[0088]

[Formula 28]



(I)

(among a formula, R^5 expresses the organic group of the carbon numbers 1-6, and n expresses the number of 3-10.) — the annular organopolysiloxane which is expressed and which has at least two SiH groups in one molecule is preferred.

[0089] As for substituent R^2 in the compound expressed with general formula (II), it is preferred that it is what comprises C, H, and O, it is more preferred that it is a hydrocarbon group, and it is still more preferred that it is a methyl group.

[0090] As a compound expressed with general formula (II), it is preferred from a viewpoint of acquisition ease that it is 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane.

[0091] (B) Although restrictions in particular do not have a molecular weight of an ingredient and arbitrary things can use it conveniently, from a viewpoint of being easier to reveal mobility, the thing of low molecular weight is used preferably. Specifically the thing of 50-100,000 has a preferred molecular weight, the thing of 50-1,000 is more preferred, and the thing of 50-700 is still more preferred.

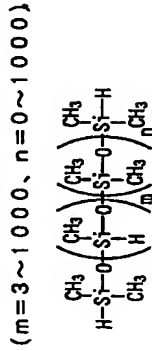
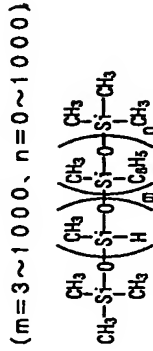
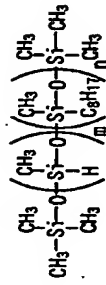
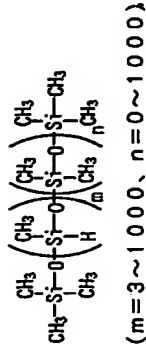
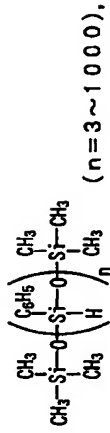
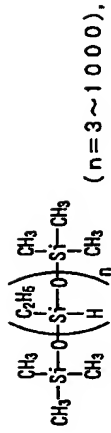
[0092] (B) Independent, two or more sorts of things are mixed, and an ingredient can be used.

[0093] (A) From a viewpoint of having an ingredient and good compatibility, and a viewpoint of being hard to produce a problem of outgas from encapsulant that the volatility of the (B) ingredient can become low. (B) An organic compound (alpha) which contains a carbon-carbon double bond in which an ingredient has a SiH group and reactivity in [one or more] one molecule, it is preferred that it is a compound which can obtain a chain and/or annular polyorganosiloxane (beta) which has at least two SiH groups by the ability to carry out a hydrosilylation reaction in one molecule.

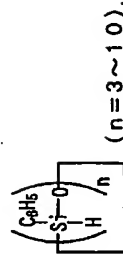
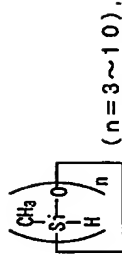
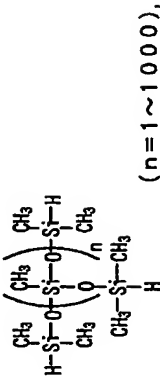
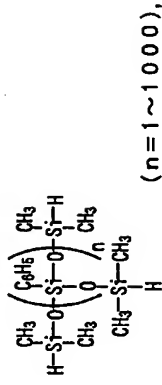
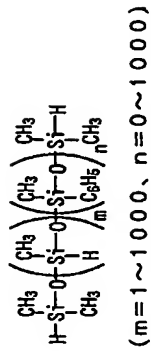
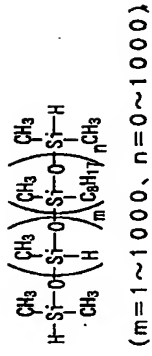
(alpha) The ingredient (alpha) can also use here the same thing (alpha 1) as a SiH group and an organic compound which contains a carbon-carbon double bond which has reactivity in [at least two] one molecule which are the above-mentioned (A) ingredients (ingredient). (alpha 1) Crosslinking density of a hardened material which will be obtained if an ingredient is used becomes high, and dynamics intensity serves as reliable high encapsulant easily.

[0094] In addition, an organic compound (alpha 2) which contains a carbon-carbon double bond which has a SiH group and reactivity in [one] one molecule can also be used. (alpha 2) A hardened material which will be obtained if an ingredient is used serves as low elasticity easily, and serves as reliable encapsulant easily by low stress.

(alpha 2) Especially if it is an organic compound which contains as an ingredient a carbon-carbon double bond which has a SiH group and reactivity in [one] one molecule, will not be limited, but (alpha 2). (ingredient) (B) In a point that the (A) ingredient and compatibility become good in an ingredient, it is preferred that it is what does not include siloxane units (Si-O-Si) like polysiloxane organicity block copolymer or a polysiloxane organicity graft copolymer as a compound, and contains only C, H, N, O, S, and halogen as a composing element.



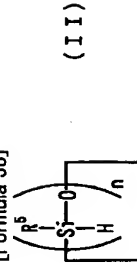
[0118]
[Formula 37]



[0119] From a viewpoint that compatibility with an ingredient (alpha) becomes good easily here to following general formula (II)

[0120]

[Formula 38]



(among a formula, R² expresses the organic group of the carbon numbers 1-6, and n expresses the number of 3-10.) — the annular polyorganosiloxane which is expressed and which has at least three SiH groups in one molecule is preferred.

[0121] As for substituent R² in a compound expressed with general formula (II), it is preferred that it is what comprises C, H, and O, it is more preferred that it is a hydrocarbon group, and it is still more preferred that

it is a methyl group.

[0122]From acquisition ease etc., it is preferred that it is 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane.

[0123]A thing [a thing] described above and which are independent, or mixes two or more sorts of things, and is used is possible for an ingredient in some numbers (beta).

A hydrosilylation reaction of an ingredient (alpha) and an ingredient (beta) in a case of using a compound which can obtain an ingredient (alpha) and an ingredient (beta) by the ability to carry out a hydrosilylation reaction as ((alpha) a reaction of an ingredient and an ingredient (beta)), next a (B) ingredient of this invention is explained.

[0124]When the hydrosilylation reaction of an ingredient (alpha) and the ingredient (beta) is carried out, a mixture of two or more compounds containing the (B) ingredient of this invention may be obtained, but without separating the (B) ingredient from there, it can use with a mixture and a hardenability constituent of this invention can also be created.

[0125](alpha) The mixing ratio of an ingredient (alpha) in a case of carrying out the hydrosilylation reaction of an ingredient and the ingredient (beta), and an ingredient (beta), Although not limited in particular, when intensity of a hardened material by hydrosilylation with the (B) ingredient and the (A) ingredient which are obtained is considered, since a direction with many SiH groups of the (B) ingredient is preferred, It is preferred that a ratio with a total (Y) of a SiH group in an ingredient (beta) mixed with total (X) of a carbon-carbon double bond which has reactivity with a SiH group in an ingredient (alpha) generally mixed is $Y/X \geq 2$, and it is more preferred that it is $Y/X \geq 3$. From a point that compatibility with the (A) ingredient of the (B) ingredient becomes good easily, it is preferred that it is $10 \geq Y/X$ and it is more preferred that it is $5 \geq Y/X$.

[0126](alpha) A suitable catalyst may be used when carrying out the hydrosilylation reaction of an ingredient and the ingredient (beta). As a catalyst, the following can be used, for example. A thing which made carriers, such as a simple substance of platinum, alumina, silica, and carbon black, support solid platinum. A complex with chloroplatinic acid, chloroplatinic acid, alcohol, aldehyde, ketone, etc., Platinum-olefin complex (for example, it $\text{Pt}(\text{CH}_2-\text{CH}_2-\text{CH}_2)_2(\text{PPh}_3)_2$ and $\text{Pt}(\text{CH}_2=\text{CH}_2)_2\text{Cl}_2$, Platinum-vinyl siloxane complex (for example, it $\text{Pt}(\text{VMe}_2-\text{SiOSiMe}_2)_2\text{V}_n$ and $\text{Pt}(\text{MeVSiO})_4$), a platinum-phosphine complex. (For example, $\text{Pt}(\text{PPh}_3)_4$, a platinum-phosphite complex (for example, $\text{Pt}(\text{P(Ph)}_3)_4$ and $\text{Pt}(\text{P(OBu)}_3)_4$ (among a formula, a methyl group and Bu express a butyl group, Vi expresses a vinyl group, Ph expresses a phenyl group as for Me, and n and m) An integer is shown. A platinum-hydrocarbon complex indicated in dicarbonyl dichloroplatinum, a curl SHUTETO (Karstedt) catalyst, U.S. Pat. No. 3159601 of Ashby (Ashby), and the No. 3159662 specification. And a platinum alcoholate catalyst indicated in a U.S. Pat. No. 3220972 specification of RAMORO (Lamoreaux) is mentioned. A platinum chloride-olefin complex indicated in a U.S. Pat. No. 3516946 specification of Modic (Modic) is also useful in this invention.

[0127]As an example of catalysts other than a platinum compound, $\text{RhCl}(\text{PPh})_3$, RhCl_3 , RhAl_2O_3 , RuCl_3 , IrCl_3 , FeCl_3 , AlCl_3 , PdCl_2 , and $2\text{H}_2\text{O}$, NiCl_2 , TiCl_4 , etc. are mentioned.

[0128]In these, chloroplatinic acid, a platinum-olefin complex, a platinum-vinyl siloxane complex, etc. are preferred from a point of catalytic activity. These catalysts may be used alone and may be used together two or more sorts.

[0129]Although an addition in particular of a catalyst is not limited, in order to have sufficient hardenability and to hold down cost of a hardenability constituent comparatively low a minimum of a desirable addition, (beta) as opposed to 1 mol of SiH groups of an ingredient — 10^{-8} mol — are 10^{-6} mol more preferably and a maximum of a desirable addition receives 1 mol of SiH groups of an ingredient (beta) — 10^{-1} mol — it is 10^{-2} mol more preferably. Here [here] It is possible again to use a co-catalyst together for the above-mentioned catalyst. Amine system compounds, such as sulfur-systems compounds, such as sulfur of acetylene alcohol system compounds, such as 1, such as the Lynn system compounds, such as triphenyl phosphine, and dimethyl maleate, 2-diester system compound, and a 2-hydroxy-2-methyl-1-butene, and a simple substance, and triethylamine, etc. are mentioned as an example. A minimum [as opposed to / although an addition in particular of a co-catalyst is not limited / 1 mol of hydrosilylation catalysts] of a desirable addition — 10^{-2} mol — it is 10^{-1} mol more preferably — a maximum of a desirable addition —

10^2 mol — it is 10 mol more preferably.

[0130]Although various methods can be taken as the method of mixing of an ingredient (alpha) in a case of making it react, an ingredient (beta), and a catalyst, a method of mixing ***** (beta) for what mixed a catalyst for an ingredient (alpha) is preferred. (alpha) Control of a reaction is difficult in case of a method of mixing a catalyst into a mixture of an ingredient and an ingredient (beta). (beta) Since it has moisture and reactivity which an ingredient is mixing under existence (beta) of a catalyst when taking a method of mixing an ingredient (alpha) to what mixed a catalyst with an ingredient, it may deteriorate.

[0131]Although many things can be set up as reaction temperature, 30 ° of minimums of a desirable temperature requirement are 50 ° more preferably in this case, and 200 ° of maximums of a desirable temperature requirement are 150 ° more preferably. It is not practical if reaction time for making it fully react will become long if reaction temperature is low, and reaction temperature is high. Although a reaction may be performed at a fixed temperature, a multi stage story or per-continuum temperature may be changed if needed.

[0132]A pressure of reaction time and reaction time can also be set up variously if needed.

[0133]A solvent may be used in the case of a hydrosilylation reaction. A solvent which can be used is not what is limited especially unless a hydrosilylation reaction is checked. If it illustrates concretely,

hydrocarbon system solvents, such as benzene, toluene, hexane, and heptane, Halogen system solvents, such as ketone solvent [such as ether system solvents, such as tetrahydrofuran 1, 4-dioxane, 1,3-dioxolane and diethylether, acetone, and methyl ethyl ketone,], chloroform, methylene chloride, 1, and 2-dichloroethane, can be used conveniently. A solvent can also be used as two or more kinds of mixed solvents. As a solvent, toluene, a tetrahydrofuran, 1,3-dioxolane, and chloroform are preferred. The amount of solvents to be used can also be set up suitably.

[0134]In addition, various additive agents may be used for the purpose of controlling reactivity etc.

[0135](alpha) After making an ingredient and an ingredient (beta) react, a solvent or/and an unreacted (alpha) ingredient or/ and (beta) an ingredient are also removable. Since the (B) ingredient obtained does not have volatile matter content, it is hard to produce a problem of a void by volatilization of volatile matter content, and a crack by removing such volatile matter content in hardening with the (A) ingredient. As a method of removing, processing by activated carbon, aluminum silicate, silica gel, etc. besides for example, decompression devolatilization, etc. are mentioned. When carrying out decompression devolatilization, processing at low temperature is preferred. A maximum of a desirable temperature in this case is 100 °, and is 60 ° more preferably. If it processes at an elevated temperature, it will be easy to be accompanied by deterioration of thickening etc.

[0136]As an example of the (B) ingredient which is a reactant of above ingredients (alpha) and ingredients (beta), A reactant of bisphenol A diaryl ether and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of a vinylcyclohexene and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of divinylbenzene and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of a dicyclopentadiene and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of triallyl isocyanurate and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of diaryl monoglycidyl isocyanurate and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of allyl glycidyl ether and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, A reactant of alpha methylstyrene, a reactant of 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane and monoallyl diglycidyl isocyanurate, and 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane, etc. can be mentioned.

(Mixing of the (A) ingredient and the (B) ingredient) About combination of the (A) ingredient and the (B) ingredient, various combination of things quoted as an example of a thing quoted as an example of the (A) ingredient, and those various mixtures / (B) ingredient and those various mixture * can be mentioned. [0137](A) In a ratio [as opposed to / the mixing ratio of an ingredient and the (B) ingredient is not limited especially unless required intensity is lost, but / number (X) of a carbon-carbon double bond in the (A) ingredient of the number of SiH groups in the (B) ingredient (Y)], a minimum of a desirable range — $Y/X \geq 0.3$ — more — desirable — $Y/X \geq 0.5$ — it is $Y/X \geq 0.7$ still more preferably — a maximum of a desirable range — $3 \geq Y/X$ — more — desirable — $2 \geq Y/X$ — it is $1.5 \geq Y/X$ still more preferably. When it shifts, sufficient intensity is not obtained or it becomes easy to carry out heat deterioration from a desirable range.

((C) ingredient) A hydrosilylation catalyst which is next the (C) ingredient is explained.

[0138]As a hydrosilylation catalyst, especially if there is catalytic activity of a hydrosilylation reaction, will

not be limited, but, for example, a thing which made carriers, such as a simple substance of platinum, alumina, silica, and carbon black, support solid platinum. A complex with chloroplatinic acid, chloroplatinic acid, alcohol, aldehyde, ketone, etc., platinum-olefin complex (for example, $\text{Pt}(\text{CH}_2=\text{CH}-\text{CH}_2)_2(\text{PPh}_3)_3$), $\text{Pt}(\text{CH}_2=\text{CH}_2)_2\text{Cl}_2$, platinum-vinyl siloxane complex (for example, $\text{Pt}(\text{ViMe}-\text{SiOSiMe}_2)_2$), a platinum-phosphite complex (for example, $\text{Pt}(\text{P}(\text{OPh})_3)_3$ and $\text{Pt}(\text{P}(\text{OBu})_3)_4$ (among a formula, a methyl group and Bu express a butyl group, Vi expresses a vinyl group, Ph expresses a phenyl group as for Me, and n and m show an integer), dicarbonyl dichloroplatinum, and a curl SHUTETO (Karstedt) catalyst. A platinum alcoholate catalyst indicated in a platinum-hydrocarbon complex indicated in U.S. Pat. No. 3159601 of Ashby (Ashby) and the No. 3159662 specification and a U.S. Pat. No. 3220972 specification of RAMORO (Lamoreaux) is mentioned. A platinum chloride-olefin complex indicated in a U.S. Pat. No. 3516946 specification of Modic (Modic) is also useful in this invention.

[0139] As an example of catalysts other than a platinum compound, $\text{RhCl}(\text{PPh}_3)_3$, RhCl_3 , $\text{Rh}(\text{A})_2\text{O}_3$, RuCl_3 , IrCl_3 , FeCl_3 , AlCl_3 , PdCl_2 , and $2\text{H}_2\text{O}$, NiCl_2 , TiCl_4 , etc., are mentioned.

[0140] In these, chloroplatinic acid, a platinum-olefin complex, a platinum-vinyl siloxane complex, etc., are preferred from a point of catalytic activity. These catalysts may be used alone and may be used together two or more sorts.

[0141] Although an addition in particular of a catalyst is not limited, in order to have sufficient hardenability and to hold down cost of a hardenability constituent comparatively low a minimum of a desirable addition, (B) as opposed to 1 mol of SiH groups of an ingredient — 10^{-8} mol — are 10^{-6} mol more preferably and a maximum of a desirable addition receives 1 mol of SiH groups of an ingredient (beta) — 10^{-1} mol — it is 10^{-2} mol more preferably.

[0142] It is possible to use a co-catalyst together for the above-mentioned catalyst, and as an example The Lynn system compounds, such as triphenyl phosphine, amine system compounds, such as sulfur-systems compounds, such as sulfur of acetylene alcohol system compounds, such as 1, such as dimethyl maleate, 2-diester system compound, and a 2-hydroxy-2-methyl-1-butene, and a simple substance, and triethylamine, etc., are mentioned, a minimum [as opposed to / although an addition in particular of a co-catalyst is not limited / 1 mol of hydrosilylation catalysts] of a desirable addition — 10^{-2} mol — it is 10^{-1} mol more preferably — a maximum of a desirable addition — 10^2 mol — it is 10 mol more preferably. A filler which are ((D) ingredient), next the (D) ingredient is explained.

[0143] (D) Although various kinds of things are used as a filler of an ingredient, for example, quartz, fume silica, sedimentation nature silica, a silicic acid anhydride, fused silica, silica system fillers, such as crystalline silica and superfines amorphous silica, silicon nitride, silver dust, alumina, aluminum hydroxide, titanium oxide, glass fiber, carbon fiber, inorganic fillers, such as mica, carbon black, graphite, diatomite, clay, clay, talc, calcium carbonate, magnesium carbonate, barium sulfate, and an inorganic balloon, are made into the start. Generally use or / a filler proposed, etc., can be mentioned as a filler of the conventional sealing agents, such as an epoxy system.

[0144] (D) From a viewpoint of being hard to give a damage as a filler of an ingredient to a semiconductor and an electronic industry material to close, it is preferred that it is low radiation nature.

[0145] (D) The surface treatment of the filler of an ingredient may be carried out suitably. As a surface treatment, alkylation processing, trimethylsilylation processing, silicization, processing by a coupling agent, etc., are mentioned.

[0146] A silane coupling agent is mentioned as an example of a coupling agent in this case. It will not be limited especially if it is a compound which has respectively an organic group, an existing reactant functional group, and at least one silicon group of hydrolysis nature in a molecule as a silane coupling agent. As an organic group and an existing reactant basis, an epoxy group from a point of handling nature, an methacrylic group, at least one functional group chosen from an acrylic group, an isocyanate group, an isocyanurate group, a vinyl group, and a carbamate group is preferred, and an epoxy group, an methacrylic group, and especially an acrylic group are preferred from hardenability and an adhesive point. As a silicon group of hydrolysis nature, a point of handling nature to alkoxy silyl groups is preferred, and especially a methoxy silyl group and ethoxy silyl group is preferred from a reactant point.

[0147] As a desirable silane coupling agent, 3-glycidyloxypropyltrimethoxysilane, 3-glycidyloxypropyltriethoxysilane, 2-(3, 4-epoxycyclohexyl) ethyltriethoxysilane, The alkoxy silane which has epoxy functional groups, such as 2-(3, 4-epoxycyclohexyl) ethyltriethoxysilane : 3-methacryloxy propyl trimethoxysilane, 3-methacryloxypropyl triethoxysilane, 3-acryloxypropyltrimethoxysilane, 3-acryloxypropyltriethoxysilane, meta-KURIROKISHI methyl trimethoxysilane, The alkoxy silane which has an methacrylic group or acrylic groups, such as meta-KURIROKISHI methyl triethoxysilane, acryloxy methyl trimethoxysilane, and acryloxy methyl triethoxysilane, can be illustrated.

[0148] In addition, a method of adding a filler of the (D) ingredient is mentioned. For example, a hydrolytic silane monomer or oligomer, such as alkoxy silane, an acyloxy silane, and halogenation Silang. A method of adding to a constituent of this invention, making an alkoxide of metal, such as titanium and aluminum, reed ROKUSHIDO, a halogenide, etc., reacting in a constituent or a partial reactant of a constituent, and making a filler generating in a constituent can also be mentioned.

[0149] From a viewpoint that are hard to check a hardening reaction among fillers of the above (D) ingredients, and the reduction effect of a coefficient of linear expansion is large, a silica system filler is preferred.

[0150] (D) In a point that perviousness to a slit of a sealing agent becomes good easily as mean particle diameter of a filler of an ingredient, it is preferred that it is 10 micrometers or less, and it is more preferred that it is 5 micrometers or less.

[0151] (D) If a particle with a particle diameter of not less than 50 micrometers of a filler of an ingredient carries out comparatively, in a point that perviousness to a slit of a sealing agent becomes good easily, it is preferred that it is 1 or less % of the weight, and it is more preferred that it is 0.1 or less % of the weight. [0152] (D) About particle size distribution of a filler of an ingredient, as a filler of the conventional sealing agents, such as an epoxy system, use or /, and a thing proposed are begun, and various setting out of it can be carried out. For example, it may be made for a particle (15 % of the weight or more and 1 micrometer or less) to be 3 % of the weight or more in a not less than 24-micrometer particle.

[0153] (D) A rate of a with mean particle diameter of a filler of an ingredient and a particle diameter [of a filler] of not less than 50 micrometers particle can be measured using a laser method micro track grading analysis meter.

[0154] (D) Also with specific surface area of a filler of an ingredient, as a filler of the conventional sealing agents, such as an epoxy system, use or /, and a thing proposed are begun, and various setting out of it can be carried out. For example, more than $4\text{-m}^2/\text{g}$ can set up below $4\text{-m}^2/\text{g}$ and below $10\text{-m}^2/\text{g}$ arbitrarily.

[0155] Specific surface area can be measured with a BET adsorption method mono-SOBU surface area measuring instrument.

[0156] (D) Also with a vitrification rate of a filler of an ingredient, as a filler of the conventional sealing agents, such as an epoxy system, use or /, and a thing proposed are begun, and various setting out of it can be carried out. For example, it can set up arbitrarily not less than 97 etc. % etc.

[0157] (D) As shape of a filler of an ingredient, it is preferred that it is a spherical filler from a viewpoint to which viscosity of a sealing agent becomes low easily.

[0158] (D) A filler of an ingredient may be used alone and may be used together two or more sorts. [0159] (D) Although an addition in particular of a filler of an ingredient is not limited, the reduction effect of a coefficient of linear expansion is high, and — encapsulant — mobility — being good — saying — a viewpoint — from — it is desirable — an addition — a minimum — all — encapsulant — inside — 30 — % of the weight — more — desirable — 50 — % of the weight — it is — it is desirable — an addition — a maximum — all — encapsulant — inside — 80 — % of the weight — more — desirable — 70 — % of the weight — it is .

(Mixing) Although various methods can be taken as the method of mixing of the (A) ingredient, the (B) ingredient, the (C) ingredient, and the (D) ingredient. In a point that the storage stability of an intermediate material of a sealing agent becomes good easily, what mixed the (C) ingredient and the (D) ingredient for the (A) ingredient, and a method of mixing the (B) ingredient are preferred. (B) When taking a method of mixing the (A) ingredient to what mixed the (C) ingredient or /, and the (D) ingredient for an ingredient, (C) Since the (B) ingredient has that of moisture in environment or /, and the (D) ingredient, and reactivity under ingredient existence or / and nonexistence, it may deteriorate in the storage middle class. (Additive agent)

(Concrete retarder) A concrete retarder can be used in order to adjust the reactivity of a hydrosilylation reaction in the purpose of improving the preservation stability of $\ast\ast$, or a manufacturing process to encapsulant of this invention. As a concrete retarder, a compound, an organophosphorus compound, an organic sulfur compound, a nitrogen containing compound, a tin series compound, organic peroxide, etc. containing aliphatic unsaturated bonds are mentioned, and these may be used together. As a compound containing aliphatic unsaturated bonds, propargyl alcohol, ene-yne compounds, and ester maleate are illustrated. As an organophosphorus compound, Tori ORGANO phosphoretted hydrogen, JIORUGANO phosphoretted hydrogen, ORGANO Foss John, and trioganot phosphite are illustrated. As an organic sulfur compound, the ORGANO mercaptans, JIORUGANO sulfides, hydrogen sulfide, benzothiazole, a benzothiazole disulfide, etc. are illustrated. As a nitrogen containing compound, ammonia, the 1-3rd class alkylamine, arylamines, urea, hydrazine, etc. are illustrated. As a tin series compound, first tin of halogenation 2 hydrate, the first tin of carboxylic acid, etc. are illustrated. As organic peroxide, di-*t*-butylperoxide, dicumyl peroxide, benzoyl peroxide, perbenzoic acid *t*-butyl, etc. are illustrated. [0160] Delay activity is good among these concrete retarders, and a benzothiazole, thiazole, dimethylmalate, and 3-hydroxy-3-methyl-1-butene is preferred from a viewpoint that raw material availability is good. [0161] A minimum of a desirable addition to 1 mol of hydrosilylation catalysts used although various additions of a concrete retarder can be set up 10^{-1} mol — it is 1 mol more preferably — a maximum of a desirable addition 10^3 mol — it is 50 mol more preferably.

[0162] These concrete retarders may be used alone and may be used together two or more sorts. (Adhesive improving agent) An adhesive improving agent can also be added in encapsulant of this invention. Everything but adhesives generally used as an adhesive improving agent, for example, various coupling agents. An epoxy compound, phenol resin, coumarone-indene resin, rosin ester resin, terpene phenol resin, a alpha-methylstyrene vinyltoluene copolymer, polyethylmethylstyrene, aromatic polyisocyanate, etc. can be mentioned.

[0163] A silane coupling agent is mentioned as a coupling agent. It will not be limited especially if it is a compound which has respectively an organic group, an existing reactant functional group, and at least one silicon group of hydrolysis nature in a molecule as a silane coupling agent. As an organic group and an existing reactant basis, an epoxy group from a point of handling nature, an methacrylic group. At least one functional group chosen from an acrylic group, an isocyanate group, an isocyanurate group, a vinyl group, and a carbamate group is preferred, and an epoxy group, an methacrylic group, and especially an acrylic group are preferred from hardenability and an adhesive point. As a silicon group of hydrolysis nature, a point of handling nature to alkoxy silyl groups is preferred, and especially a methoxy silyl group and ethoxy silyl group is preferred from a reactant point.

[0164] As a desirable silane coupling agent, 3-glycidyloxypropyltrimethoxysilane, 3-glycidyloxypropyltriethoxysilane, 2-(3, 4-epoxycyclohexyl) ethyltrimethoxysilane, The alkoxy silane which has epoxy functional groups, such as 2-(3,4-epoxycyclohexyl) ethyltriethoxysilane : 3-methacryloxy propyl trimethoxysilane, 3-methacryloxypropyl triethoxysilane, 3-acryloxypropyltriethoxysilane, 3-acryloxypropyltriethoxysilane, meta-KURIROKISHI methyl triethoxysilane, The alkoxy silane which has an methacrylic group or acrylic groups, such as meta-KURIROKISHI methyl triethoxysilane, acryloxy methyl trimethoxysilane, and acryloxy methyl triethoxysilane, can be illustrated.

[0165] Although many things can be set up as an addition of a silane coupling agent, minimums of a desirable addition to [ingredient + (B) (A) Ingredient] 100 weight section are 0.5 weight sections more preferably 0.1 weight sections, and maximums of a desirable addition are 25 weight sections more preferably 50 weight sections. If there are few additions, the adhesive improvement effect will not appear, but if there are many additions, it may have an adverse effect on hardened material physical properties. [0166] As an epoxy compound, for example A novolac phenol type epoxy resin, A biphenyl type epoxy resin, dicyclopentadiene type epoxy resin, Bisphenol F diglycidyl ether, bisphenol A diglycidyl ether, 2,2'-bis(4-glycidyloxy cyclohexyl)propane, 3,4-epoxycyclohexylmethyl 3,4-epoxy cyclohexane carbo KISHIRETO, Vinylcyclohexene dioxide, 2-(3,4-epoxycyclohexyl)-5,5-spiro(3,4-epoxy cyclohexane)-1,3-dioxane, A bis (3,4-epoxycyclohexyl)horse mackerel peat, screw 1,2-cyclopropanedicarboxylate glycidyl ester, triglycidyl isocyanurate, monoallyl diglycidyl isocyanurate, diaryl monoglycidyl isocyanurate, etc. can be mentioned. [0167] Although many things can be set up as an addition of an epoxy compound, minimums of a desirable addition to [ingredient + (B) (A) Ingredient] 100 weight section are three weight sections more preferably 1

weight section, and maximums of a desirable addition are 25 weight sections more preferably 50 weight sections. If there are few additions, the adhesive improvement effect will not appear, but if there are many additions, it may have an adverse effect on hardened material physical properties.

[0168] These coupling agents, a silane coupling agent, an epoxy compound, etc. may be used alone, and may be used together two or more sorts.

[0169] In order to heighten an effect of a coupling agent or an epoxy compound in this invention, a silanol condensation catalyst can be used further and adhesive improvement and/or stabilization is possible. Although not limited especially as such a silanol condensation catalyst, an aluminum system compound and/or, or a titanium system compound is preferred. As an aluminum system compound used as a silanol condensation catalyst, Aluminum TORISO propoxide, sec-butoxyaluminum JIISOFUROPOKISHIDO,

Aluminum alkoxides, such as aluminum NIUMUTORI sec-butoxide : Ethylacetateacetate aluminum diisopropoxide, aluminum tris (ethylacetateacetate). The aluminum chelate, such as aluminum tris make, alkyl acetateacetate aluminum diisopropoxide). Aluminum chelate, such as aluminum tris (acetylacetate) and an aluminum monoacetyl acetate screw (ethylacetateacetate), can be illustrated, and aluminum chelate is more preferred from a point of handling nature. As a titanium system compound used as a silanol condensation catalyst, Titanium chelate, such as tetraalkoxy titanium:titanium tetra acetylacetate, such as tetraisopropoxy titanium and tetrabutoxytitanium; A general titanate coupling agent which has residue, such as oxycetic acid and ethylene glycol, can be illustrated.

[0170] Although various the amount of [in case used of using a silanol condensation catalyst] can be set up, A minimum of a desirable addition to a coupling agent or/ and epoxy compound epoxy compound 100 weight section is one weight section more preferably 0.1 weight sections, and maximums of a desirable addition are 30 weight sections more preferably 50 weight sections. If there are few additions, the adhesive improvement effect will not appear, but if there are many additions, it may have an adverse effect on hardened material physical properties.

[0171] These silanol condensation catalysts may be used alone and may be used together two or more sorts.

[0172] In order to heighten the adhesive improvement effect further in this invention, a source compound of a silanol can be used further and adhesive improvement and/or stabilization is possible. As such a source

of a silanol, alkoxy silane, such as silanol compounds, such as a triphenylsilanol and a diphenyldihydroxy silane, diphenyldimethoxysilane, a tetramethoxy silane, and methyl trimethoxysilane, can be mentioned, for example.

[0173] Although various the amount of [in case used of using a source compound of a silanol] can be set up, A minimum of a desirable addition to a coupling agent or/ and epoxy compound epoxy compound 100 weight section is one weight section more preferably 0.1 weight sections, and maximums of a desirable addition are 30 weight sections more preferably 50 weight sections. If there are few additions, the adhesive improvement effect will not appear, but if there are many additions, it may have an adverse effect on hardened material physical properties.

[0174] These source compounds of a silanol may be used alone, and may be used together two or more sorts.

[0175] In order to heighten an effect of a coupling agent or an epoxy compound in this invention, carboxylic acid or/ and acid anhydrides can be used, and adhesive improvement and/or stabilization is possible. Although not limited especially as such carboxylic acid and acid anhydrides, [0176]

[Formula 39]

epoxy group, an amino group, a radical polymerization nature unsaturation group, a carboxyl group, an isocyanate group, hydroxyl, alkoxy silyl groups, etc. are mentioned. In a point that the heat resistance of a hardened material obtained becomes high easily, it is preferred to average a cross-linking group and to have in [one or more] one molecule.

[0188]As a molecular weight of resin made from heat plasticity, although there is no limitation in particular, in a point that compatibility with the (A) ingredient or the (B) ingredient becomes good easily, it is preferred that a number average molecular weight is 10000 or less, and it is more preferred that it is 5000 or less. On the contrary, in a point that a hardened material obtained becomes tough easily, it is preferred that a number average molecular weight is 10000 or more, and it is more preferred that it is 100000 or more. In a point that viscosity of a mixture becomes low and a moldability becomes good easily although there is no limitation in particular also about molecular weight distribution, it is preferred that molecular weight distribution is three or less, it is more preferred that it is two or less, and it is still more preferred that it is 1.5 or less.

[0189]Thermoplastics — loadings — ***** — especially — limitation — there is nothing — although — it is desirable — the amount used — a minimum — hardenability — a constituent — the whole — five — % of the weight — more — desirable — ten — % of the weight — it is — it is desirable — the amount used — a maximum — hardenability — a constituent — inside — 50 — % of the weight — more — desirable — 30 — % of the weight — it is . A hardened material which will be obtained if there are few additions becomes weak easily, and if large, heat resistance (elastic modulus in an elevated temperature) will become low easily.

[0190]A single thing may be used as thermoplastics and it may use combining two or more things.

[0191]It may melt in the (A) ingredient or/, and the (B) ingredient, and may mix as a uniform state, and it may grind, may mix by a particle state, it melts and mixes to a solvent, and thermoplastics is good also as a dispersion state. In a point that a hardened material obtained becomes transparent easier, it is preferred to melt in the (A) ingredient or/, and the (B) ingredient, and to mix as a uniform state. Also in this case, thermoplastics may be directly dissolved in the (A) ingredient or/, and the (B) ingredient, and it may mix uniformly using a solvent etc., and is good also as a uniform dispersion state or/, and the mixed state except for a solvent after that.

[0192]When making it distribute and using thermoplastics, various mean particle diameter can be set up,

but a minimum of desirable mean particle diameter is 10 nm, and a maximum of desirable mean particle diameter is 10 micrometers. Although there may be distribution of a particle system, and it may be single distribution or may have two or more peak particle sizes, from a viewpoint that viscosity of a hardenability constituent becomes it is low and good [a moldability] easily, it is preferred that a coefficient of variation of particle diameter is 10% or less.

(Antianging agent) An antiaging agent may be added to encapsulant of this invention. As an antiaging agent, an antiaging agent generally used, for example, citrate and phosphoric acid, a sulfur—systems antiaging agent, etc. are mentioned. As a sulfur—systems antiaging agent, mercaptans, salts of mercaptan, Sulfide carboxylate and the sulfides containing hindered phenol system sulfides. Polysulfide, dithiocarboxylic acid salts, thiourea, thio phosphate, a sulfonium compound, thioaldehydes, thio ketones, mercaptal, mercaptol, monothio acid, polythio acid, thioamides, and sulfoxides are mentioned.

[0193]These antiaging agents may be used alone and may be used together two or more sorts.

(Radical inhibitor) Radical inhibitor may be added to encapsulant of this invention. As radical inhibitor, for example 2,6-di-*t*-butyl-3-methyl phenol (BHT), A 2,2'-methylene-screw (4-methyl-6-*t*-butylphenol),

Phenol system radical inhibitor, such as tetrakis (methylene-3 (3,5-di-*t*-butyl-4-hydroxyphenyl) propionate) methane, Amine system radical inhibitor, such as phenyl-beta-naphthylamine, alpha-naphthylamine, the N,N'-second butyl-*p*-phenylene diamine, phenothiazin, and N,N'-diphenyl-*p*-phenylene diamine, etc. are mentioned.

[0194]These radical inhibitor may be used alone and may be used together two or more sorts.

(Ultraviolet ray absorbent) An ultraviolet ray absorbent may be added to encapsulant of this invention. As an ultraviolet ray absorbent, 2 (2'-hydroxy-3'5'-di-*t*-butylphenyl) benzotriazol, bis(2,2,6,6-tetramethyl 4-piperidine)sebacate, etc. are mentioned, for example.

[0195]These ultraviolet ray absorbents may be used alone and may be used together two or more sorts. (In addition to this additive agent) In addition to this in encapsulant of this invention, use or/, and a thing proposed are begun as a filler of the conventional sealing agents, such as an epoxy system, Colorant, a

release agent, fire retardant, a fire-resistant auxiliary agent, a surface-active agent, a defoaming agent, an emulsifier, A leveling agent, a crawling inhibitor, an ion trap agent, a thixotropic grant agent, A tackifier, a preservation stable improving agent, anti-ozonant, light stabilizer, a thickener, In a range which does not spoil the purpose and an effect of this invention, a plasticizer, reactive diluent, an antioxidant, a heat stabilizing agent, an electro-conductivity applying agent, a spray for preventing static electricity, a radiation interception agent, a nucleating additive, the Lynn system peroxide decomposition agent, lubricant, paints, a metal deactivator, a thermally conductive grant agent, a physical-properties regulator, etc. can be added. (Solvent) Encapsulant of this invention can also be dissolved and used for a solvent. If a solvent in particular that can be used is not limited and is illustrated concretely, Hydrocarbon system solvents, such as benzene, toluene, hexane, and heptane, a tetrahydrofuran, Halogen system solvents, such as ketone solvent [such as ether system solvents, such as 1, 4-dioxane, 1,3-dioxolane, and diethylether, acetone, methyl ethyl ketone, and methyl isobutyl ketone,], chloroform, methylene chloride, 1, and 2-dichloroethane, can be used conveniently.

[0196]As a solvent, toluene, a tetrahydrofuran, 1,3-dioxolane, and chloroform are preferred.

[0197]Although the amount of solvents to be used can be set up suitably, minimums of the desirable amount used to the hardenability constituent 1g to be used are 0.1mL, and maximums of the desirable amount used are 10mL. An effect of using solvents, such as hypoviscosity-izing, if there is little amount used is hard to be acquired, and if there is much amount used, a solvent will remain into material and it will be easy to become problems, such as a heat crack, and it becomes in cost and disadvantageous, and industrial-utilizations value falls.

[0198]These solvents may be used alone and can also be used as two or more kinds of mixed solvents.

(Encapsulant description) As encapsulant of this invention, as described above, can use a thing of various combination, but. In a point that restoration nature to a slit is good, as viscosity of encapsulant, it is preferred in 23 ** that they are 1000 or less Pa-s, it is more preferred that they are 10 or less Pa-s, and they are less than 5.0 Pa-s — further — this — better — it is preferred that they are especially ** and 1.0 Pa-s or less, and it is preferred that it is especially 0.1 or less. It is preferred that it is below 10 Pa and s in 100 ** for the same reason, it is more preferred that it is 1.0 or less Pa-s, and it is still more preferred that it is 0.1 or less Pa-s.

[0199]Various things can be used also about the temperature dependence (thixotropy) of viscosity.

[0200]Viscosity can be measured with E type viscosity meter.

[0201]It is preferred that penetration time to the 50-micrometer crevice at 23 ** is 600 or less seconds/cm as an infiltration speed to a crevice, and it is more preferred that it is 120 or less seconds/cm. It is preferred that penetration time to the 25-micrometer crevice at 23 ** is 600 or less seconds/cm, and it is more preferred that it is 180 or less seconds/cm. It is preferred that penetration time to the 50-micrometer crevice at 60 ** is 120 or less seconds/cm, and it is more preferred that it is 60 or less seconds/cm. It is preferred that penetration time to the 25-micrometer crevice at 60 ** is 180 or less seconds/cm, and it is more preferred that it is 120 or less seconds/cm. It is preferred that penetration time to the 50-micrometer crevice at 100 ** is 60 or less seconds/cm, and it is more preferred that it is 30 or less seconds/cm. It is preferred that penetration time to the 25-micrometer crevice at 100 ** is 120 or less seconds/cm, and it is more preferred that it is 60 or less seconds/cm.

[0202]Penetration time to a crevice is measured by a following method. After loading a cover glass of 18-mm width so that an aluminum foil spacer (25 micrometers in thickness or 50 micrometers) of two sheets may be separated 15 mm, it may arrange in parallel and it may straddle on a glass plate in the meantime as shown in drawing 1, a glass plate, an aluminum foil spacer, and a cover glass were fixed with adhesive tape. Thus, space (15mmx18mmx25micrometer or 50 micrometers) is prepared with a glass plate, aluminum foil, and a cover glass. As shown in drawing 1, after settling this thing on a hot plate, adjusting to preset temperature, and hanging down encapsulant to one side of a crevice, time until encapsulant which permeated a 1-cm position from one of them reaches is measured, and it is considered as crevice penetration time.

[0203]Although it can set up arbitrarily about the hardenability of encapsulant, it is preferred that gel time at 120 ** is less than 120 seconds, and it is more preferred that it is less than 60 seconds. It is preferred that gel time at 150 ** is less than 60 seconds, and it is more preferred that it is less than 30 seconds. It is preferred that gel time at 100 ** is less than 180 seconds, and it is more preferred that it is less than 120 seconds. When hardenability is late, workability as encapsulant worsens. Conversely, when quick,

storage stability may worsen easily.

[0204]Gel time in this case is investigated as follows. 50-micrometer-thick aluminum foil is placed on a hot plate adjusted to preset temperature, time until it hangs down and gels 100 mg of encapsulant on it is measured, and it is considered as gel time.

(Hardening) It can mix beforehand, and encapsulant of this invention can be stiffened a part of SiH group in a hardenability constituent, carbon-carbon double bond which has reactivity, SiH group, or by making ****

[0205]When making encapsulant react and making it harden, (A), (B), (C), (D) A method of mixing a back

residue to which mixed and a part was made to react, and making it react further, although it may mix at

once and an initial complement of each ingredient may be made to react. After mixing and making a part of functional group in a constituent react by control of a reaction condition, or use of a reactant difference of a substituent (formation of B stage), a method of processing shaping etc. and stiffening further can also be taken. According to these methods, viscosity control at the time of shaping becomes easy.

[0206]It can also be made to be able to react only by mixing as a method of stiffening, and can also be made to heat and react. A reaction is quick and a method of making it heat and react from a viewpoint that a heat-resistant high material is generally easy to be obtained is preferred.

[0207]Although many things can be set up as curing temperature, 30 ° of minimums of a desirable temperature are 100 ° more preferably, and 300 ° of maximums of a desirable temperature are 200 ° more preferably. If reaction temperature is low, reaction time for making it fully react will become long, and if reaction temperature is high, a fabricating operation will become difficult easily.

[0208]Although hardening may be performed at a fixed temperature, a multi stage story or per-continuum temperature may be changed if needed. rather than carrying out at a fixed temperature — a multi stage story — in a point that a uniform hardened material made it more distorted [to react] raising temperature-like or continuously and which is not is easy to be obtained, it is desirable.

[0209]Although various cure time can also be set up, it is more desirable in a point that a uniform hardened material made it more distorted [to react by a low-temperature long time comparatively] and which is not is easy to be obtained than making it react in an elevated-temperature short time.

[0210]A pressure of reaction time can also be set up variously if needed, and it can also be made to react by ordinary pressure, high voltage, or a reduced pressure state. In a point which is easy to remove volatile matter content generated by a case that restoration nature to details is good, it is preferred to make it harden by a reduced pressure state.

[0211]In a viewpoint of being hard to produce generating of a void to inside of encapsulant, and a problem of a process by outgas from encapsulant in a manufacturing process for which encapsulant is used, It is preferred that weight loss under hardening is 5 or less % of the weight, it is more preferred that it is 3 or less % of the weight, and it is still more preferred that it is 1% or less.

[0212]Weight loss under hardening is investigated as follows. Using a thermo gravity analysis apparatus, from a room temperature to 150 °, temperature up of 10 mg of the encapsulant can be carried out, an initial mass of weight which decreased can carry out it comparatively, and it can ask for it with 10 ° the heating rate for /.

[0213]In a point of being hard to cause a problem of silicone contamination to an electronic industry material, it is preferred that content of Si atom in a volatile constituent in this case is 1% or less.

(Hardened material description) That from which Tg of a hardened material in which heat resistance is obtained by stiffening encapsulant from a viewpoint of being good will be not less than 100 ° is preferred, and a thing used as not less than 150 ° is more preferred. In this case, Tg is investigated as follows. Peak temperature of tandelta of dynamic viscoelasticity measurement (IT measurement control company make DVA-200 use) which was pulled using a prismatic specimen of 3mmx5mmx30mm, and was measured on condition of for mode, 10 Hz of test-frequencies, 0.1% of distortion, ° / power ratio 1.5. and degree/of 5 ° of temperature-up side is set to Tg.

[0214]In a point that reliability becomes being hard to produce in wiring etc. which were closed when used as encapsulant highly in problems, such as ion migration, It is preferred that extraction ion content from a hardened material is less than 10 ppm, it is more preferred that it is less than 5 ppm, and it is still more preferred that it is less than 1 ppm.

[0215]In this case, extraction ion content is investigated as follows. With 50 ml of ultrapure water, the cut-out hardened material Tg is put into a container made from Teflon (R), and is sealed, and it processes on

121 **, 2 atmospheres, and conditions of 20 hours. An obtained extract is converted into concentration in a hardened material using a value of content of Na and K which were obtained by analyzing by an ICP mass analysis (Yokogawa Analytical Systems, Inc. make HP-4500 use), and it asks for it. On the other hand, the same extract is converted into concentration in a hardened material using a value of content of Cl and Br which were obtained by analyzing by the ion chromatography method (product DX[made by die ONEKUSU]-500 use, column:AS12-SC), and it asks for it. Content in a hardened material of Na, K, Cl, and Br which were obtained as mentioned above is totaled, and it is considered as extraction ion content.

(Candidate for closure) A semiconductor, electronic parts, an electronic circuit, or electric contact can be closed using encapsulant of this invention.

[0216]It sees, although usual silicon was used as a base as a semiconductor, and there is nothing then and what used various metal, such as gallium, indium, germanium, and zinc, as a base is included. In addition, an organic semiconductor is also included. Light emitting devices which are a transistor, resistance, a diode, etc. as an element, such as others and a light emitting diode and a semiconductor laser, photo detectors, such as a various sensor, a solar cell, etc. are included. Various ICs, such as a memory and a logic circuit, LSI, etc. are contained. A thing of a thing (ball semiconductor) of fineness and ball state besides a thing of plate-like [as shape of a semiconductor / usual] and block like shape, etc. are contained. A large-sized thing like 25 mm squares from an applicable for example, small thing like 0.3 mm squares or 100 mm squares may be variously used also about a semiconductor size. In addition, it can set up suitably also about connection parts, such as protective films, such as a passivation film provided on a semiconductor, a solder bump, a gold bump, an aluminum pad.

[0217]Others and automobile circumference electronic parts, liquid crystal circumference electronic parts, cell circumference electronic parts, organic electroluminescence (electroluminescence) circumference electronic parts, optical recording circumference electronic parts, etc. which are a rye backed lance, a capacitor, etc. as electronic parts are included. As automobile circumference electronic parts, electronic parts for various electronic control, such as an ignition coil and fuel supply, a gauge part article, a lighting part, etc. are mentioned, for example. As liquid crystal circumference electronic parts, others and a liquid crystal display which are light polarizer, a light filter, a transistor of TFT, a transparent conducting film, a liquid crystal, etc. are also contained, for example. As cell circumference electronic parts, a solar cell substrate, a lithium ion battery, a fuel cell, etc. are mentioned, for example. An organic electroluminescence board etc. are mentioned as organic electroluminescence (electroluminescence) circumference electronic parts. As optical recording circumference electronic parts, disc substrates VD (video disk), CD/CD-ROM, CD-R/RW, DVD-R/DVD-RAM, MO/MD, PD (phase change disk), for optical cards, etc., a light-emitting component, a pickup lens, a light sensing portion article, etc. are mentioned.

[0218]As an electric circuit, other photoelectron circuits of a rigid printed circuit board, a flexible printed circuit board, and a build up board, etc. are mentioned.

[0219]As electric contact, a node of a substrate and a cable, a node of a cable and a cable or a node of substrates, a node of a substrate and an element, a node of a cable and an element, etc. are mentioned. (Sealing method) A method of closing can also take various methods including use or/, and a thing proposed as a sealing method of the conventional sealing agents, such as an epoxy system. For example, it can also close by casting, potting, dipping, a press, coating, or screen-stencil, and molding closure can also be carried out like a transfer mold. After carrying out dispensing, it can close also by a method (under-filling) of making it permeate a crevice.

[0220]Various processing can also be performed if needed at the time of closure. For example, processing etc. which deform encapsulant or encapsulant made to react in part with centrifugality, decompression, etc. for control of a void generated at the time of closure are also applicable, and it can also deform, after closing.

[0221]Various pressure conditions at the time of closing can also be set up, and any method of ordinary pressure, decompression, and application of pressure can be applied. It is [being / where crevices, such as under-filling, are made to permeate / a case, and] sometimes effective to carry out by decompression to improve perviousness to a detailed part. Regularity may be sufficient as a pressure and it may change continuation or a stage target to a target with the passage of time if needed.

[0222]Various temperature in a case of closing can also be set up. a case where crevices, such as under-filling, are made to permeate, and a case where he would like to improve perviousness to a detailed part — warning — it is sometimes effective to carry out in the state. In this case, for example, temperature of 50

** - 200 ** is applicable. Regularity may be sufficient as temperature and it may change continuation or a stage target to a target with the passage of time if needed.
(Example of encapsulant) Although a concrete example of encapsulant is given to below, encapsulant of this invention is not limited to this.

[0223]As encapsulant of a semiconductor, a capacitor, a transistor, a diode, A light emitting diode, IC, LSI, a sensor, etc. Casting, potting, Encapsulant for closing by dipping, a transfer mold, coating, screen-stencil, etc. is mentioned. More specifically COB(s), such as a light emitting diode, IC, LSI, and a sensor. Potting encapsulants, such as COF and TAB, under-filling of a flip chip (a capillary tube flow type and a compression flow type). Encapsulant at the time of IC package mounting of BGA, CSP, etc. (under-filling for reinforcement), encapsulant for stacked IC, encapsulant for the wafer levels CSP, etc. can be mentioned. In addition, various protective films used for a semiconductor previous process, such as a passivation film, a junction coat film, and a buffer coat film, are also the examples of encapsulant of a semiconductor.

[0224]As encapsulant of electronic parts, a deflection plate, a light filter, a transistor of TFT, A protective coating agent of a transparent conducting film and a liquid crystal display, and encapsulant of a liquid crystal with which a cell was filled up, a protective coating agent of a solar cell, encapsulant of a lithium ion battery or a fuel cell, a protective coating agent of organic electroluminescence (electroluminescence), a light source for optical recording, and a coating agent of a photo detector and encapsulant — a protective coating agent of the electronic-parts circumference of a car and encapsulant are also mentioned further.

[0225]As encapsulant of an electronic circuit, a solder resist of rigid printed circuit board and flexible printed circuit board material and a build up board, a protective coating agent, etc. are mentioned.

[0226]As encapsulant of electric contact, contact protection (coating) agents, such as a substrate, an element and a substrate, a substrate and a substrate, and a cable, a junction coating agent, etc. are mentioned.

(Semiconductor device) A semiconductor device can be manufactured by closing a semiconductor by a method which was described above using encapsulant of this invention. In this case, what is necessary is to use it for a use which described encapsulant of this invention above, and just to manufacture a semiconductor device by a usual method.

[0227]A semiconductor device is a device containing various semiconductors, for example, generally DIP, QFP, SOP, TSOP, PGA, CSP, BGA, FCBGA using PI resin, ceramics, BT resin, or FR4 grade several-kinds substrate, Calling [QFN, COB, COF, TAB, the wafer level CSP, a stacked package, BCC, MCM, SIP, etc.] various IC packages, a light emitting diode part article, an optical sensor section article and a substrate in which they were carried, a module, etc. are mentioned.

[0228]

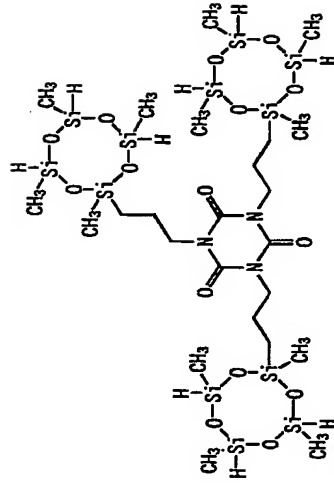
[Example]This invention is not limited by the following although the example and comparative example of this invention are shown below.

(Synthetic example 1) Agitating equipment, the tap funnel, and the condenser tube were set to the two-lot flask of 5L. The toluene 1800g, 1, 3, and 5 and 1440 g of 7-tetramethyl cyclotetrasiloxane were put into this flask, and it heated and stirred in a 120 ** oil bath. The mixed liquor of 1.44 ml of xylene solutions (3wt% as platinum content) of 200 g of triallyl isocyanurate, 200g of toluene, and a platinum vinyl siloxane complex was dropped over 50 minutes. After warming and stirring the obtained solution as it was for 6 hours, decompression distilling off of unreacted 1,3,5,7-tetramethyl cyclotetrasiloxane and toluene was carried out. It turned out that, as for this thing, a part of SiH group of 1, 3, 5, and 7-tetramethyl

cyclotetrasiloxane reacts to triallyl isocyanurate by ¹H-NMR (the reactant A is called). When 1,2-dibromomethane was used for the internal standard and the content of the SiH group was calculated by ¹H-NMR, it turned out that the SiH group of 8.08 mmol/g is contained. Although output is a mixture, the following which are the (B) ingredient of this invention are contained as the main ingredients. The platinum vinyl siloxane complex which is the (C) ingredient of this invention is contained.

[0229]

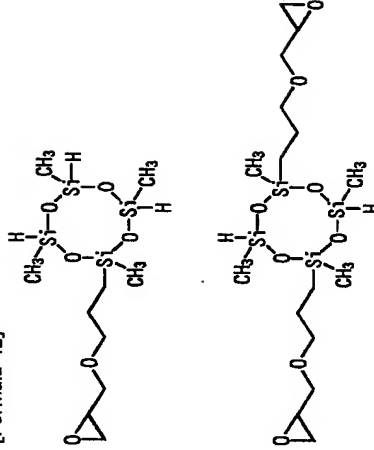
[Formula 41]



(Synthetic example 2) The magnetic stirring child, the tap funnel, and the condenser tube were set to the four-lot flask of 1L. The toluene 200g, 1, 3, and 5 and 200 g of 7-tetramethyl cyclotetrasiloxane were put into this flask, and it heated and stirred at 50 ** in the bottom oil bath of a nitrogen atmosphere. Xylene solution (3wt% as platinum content) 31.5microL of the allyl glycidyl ether 95.0g and a platinum vinyl siloxane complex and the mixture of 50 g of toluene were dropped over 30 minutes from the tap funnel. After heating by the ** for 1 hour, decompression distilling off of unreacted 1, 3 and 5, 7-tetramethyl cyclotetrasiloxane, and the toluene was carried out. It turned out that a part of SiH group of 1, 3, 5, and 7-tetramethyl cyclotetrasiloxane carries out the hydrosilylation reaction of this thing with allyl glycidyl ether by ¹H-NMR (the reactant B is called). When 1,2-dibromomethane was used for the internal standard and the content of the SiH group was calculated by ¹H-NMR, it turned out that the SiH group of 6.63 mmol/g is contained. Although output is a mixture, the following which are the (B) ingredient of this invention are contained as the main ingredients. The platinum vinyl siloxane complex which is the (C) ingredient of this invention is contained.

[0230]

[Formula 42]



(Examples 1 and 2) Encapsulant was created using the reactants A and B compounded in the synthetic examples 1 and 2 as a (B) ingredient by the combination shown in the table using spherical silica as a (D) ingredient, using a platinum vinyl siloxane complex as a (C) ingredient, using triallyl isocyanurate as a (A) ingredient.

[0231]Viscosity, crevice penetration time, the weight loss under hardening, and gel time were measured using such encapsulants.

[0232]Such encapsulants were put into the ointment can so that it might become a depth of 3 mm, it heated gradually in 150 **/the way of 1 hour, and the hardened material was obtained [for 60 **/6 hours] for 120 **/1 hour for 80 **/1 hour for 70 **/1 hour. Tg and extraction ion content were measured using this hardened material.

[Translation done.]

[0233]

[Table 1]

配合	トリアルキルアンモニウム塩	実量割合1	実量割合2
反応物A		12.1g	10.0g
反応物B		18.0g	
自食乾燥液			18.2g
溶媒		80mg	85mg
酸化還元剤		32.1g	28.7g
重合付与剤1		80mg	85mg
重合付与剤2		1.61g	
重合付与剤3		0.30g	0.28g
重合付与剤4			
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重合付与剤6			
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白金城製薬:白金ニニルンロキヤノ原料のキシレン溶液(白金比で3wt%含有)
 克星科:球状シリカ(日本化学社製、シリスタールE55(平均粒径4.8 μ m、50 μ m以上の粒子の含有率0.0%))
 渡辺薬品:エーチニルシクロヘキサンール
 彼者付与剤1:グリシドキンプロピロリルオキシゲン
 彼者付与剤2:アルミニウムエスチアセテート

Viscosity: The viscosity in 23 °C was measured with E type viscosity meter.

[2324] Crevice penetration time: The aluminum foil spacer was put with the glass plate of two sheets, and the crevice between 50-micrometer thickness 1.8 cm in length was created by 15-mm width like drawing 2. After settling this thing on the hot plate, adjusting to preset temperature, and hanging down encapsulant to one side of a crevice, time until the encapsulant which permeated a 1-cm position from one side reaches was measured.

[0235]Weight loss under hardening: Using the thermo gravity analysis apparatus, from a room temperature to 150 **, temperature up of about 10 mg of the encapsulant was carried out, the initial mass of the weight which decreased carried out it comparatively, and it asked for it with 10 ** the heating rate for / .

[0236]Gel time: 50-micrometer-thick aluminum foil was placed on the hot plate adjusted to preset temperature, and time until it hangs down and gels about 100 mg of encapsulant on it was measured.

[0237] Pull using the prismatic specimen of Tg 3mmx5mmx30mm of a hardened material, and The mode, It asked with the peak temperature of tandelta of the dynamic viscoelasticity measurement (IT measurement control company make DVA-200 use) measured on condition of for 10 Hz of test-frequencies, 0.1% of distortion, ** / power ratio 1.5, and degree/of 5 ** of temperature-up side.

[0238] Extraction ion content: With 50 ml of ultrapure water, about 1 g of cut-out hardened materials were put into the container made from Teflon (R), and were sealed, and it processed on 121 °C, 2 atmospheres, and the conditions of 20 hours. The obtained extract was converted into the concentration in the hardened material using the value of the content of Na and K which were obtained by analyzing by an ICP mass analysis (Yokogawa Analytical Systems, Inc. make HP-4500 use), and it asked for it. On the other hand, the same extract was converted into the concentration in the hardened material using the value of the content of Cl and Br which were obtained by analyzing by the ion chromatography method (product DXI made by die ONEKUSU J-500 use, column:AS12-SC), and it asked for it. The content in the hardened material of Na, K, Cl, and Br which were obtained as mentioned above was totaled, and it was considered as extraction ion content.

[0239] When that with which the 50- μ meter crevice which used such encapsulants for crevice penetration time measurement was filled up was heated for 10 minutes in 150 °C hot wind oven, it became a hard hardened material.

[0240] The encapsulant of this invention has the characteristic which are hypoviscosity and low-temperature fast curability and was excellent as encapsulant. Therefore, a reliable semiconductor device can be manufactured using this.

* NOTICES *

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a perspective view of the jig used for measurement of the penetration time to the crevice concerning this invention.

[Drawing 2]It is a perspective view of the jig used for measurement of the penetration time to the crevice concerning this invention.

[Translation done.]

* NOTICES *

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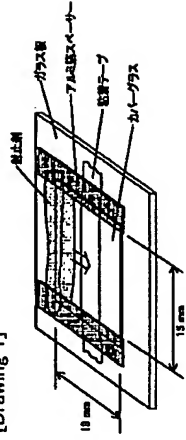
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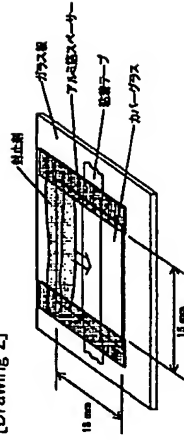
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]